National Institute of Environmental Health Sciences

Mapping and predicting malaria transmission in the People's Republic of China, using integrated biology-driven and statistical models

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Abstract:

The purpose of this study was to deepen our understanding of Plasmodium vivax malaria transmission patterns in the People's Republic of China (P. R. China). An integrated modeling approach was employed, combining biological and statistical models. A Delphi approach was used to determine environmental factors that govern malaria transmission. Key factors identified (i.e. temperature, rainfall and relative humidity) were utilized for subsequent mapping and modeling purposes. Yearly growing degree days, annual rainfall and effective yearly relative humidity were extracted from a 15-year time series (1981-1995) of daily environmental data readily available for 676 locations in P. R. China. A suite of eight multinomial regression models, ranging from the null model to a fully saturated one were constructed. Two different information criteria were used for model ranking, namely the corrected Akaike's information criterion and the Bayesian information criterion. Mapping was based on model output data, facilitated by using ArcGIS software. Temperature was found to be the most important environmental factor, followed by rainfall and relative humidity in the Delphi evaluation. However, relative humidity was found to be more important than rainfall and temperature in the ranking list according to the three single environmental factor regression models. We conclude that the distribution of the mosquito vector is mainly related to relative humidity, which thus determines the extent of malaria transmission. However, in regions with relative humidity >60%, temperature is the major driver of malaria transmission intensity. By integrating biology-driven models with statistical regression models, reliable risk maps indicating the distribution of transmission and the intensity can be produced. In a next step, we propose to integrate social and health systems factors into our modeling approach, which should provide a platform for rigorous surveillance and monitoring progress towards P. vivax malaria elimination in P.R. China.

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Resource Description

Early Warning System: ☑

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure : ☑

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Meteorological Factors, Precipitation, Temperature

Temperature: Fluctuations

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Asia

Asian Region/Country: China

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Short-Term (

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content